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THE FLORA OF PENIKESE, FIFTY YEARS AFTER.

Edited by I. F. Lewis.

(Plates 146 and 147.)

INTRODUCTION.

The island of Penikese, lying in Buzzard's Bay, twelve miles south of New Bedford, is the westernmost of the Elizabeth Islands. It is famous among American biologists as the first home of the Anderson School of Natural History, better known as "Agassiz's Laboratory," the sessions of which were held in 1873–1874. In 1873 a botanical survey of the island was made by one of the brilliant members of the group of students attracted by the Master. It is not very generally known that David Starr Jordan, distinguished as a zoologist and author, began his scientific career with "The Flora of Penikese Island," published in the American Naturalist, volume 8, April, 1874.

The fiftieth anniversary of the foundation of the Agassiz school at Penikese was held in the summer of 1923. At the same time a biological survey of the island was undertaken jointly by workers from the United States Bureau of Fisheries Laboratory and the Marine Biological Laboratory at Woods Hole, Massachusetts. One day was devoted to collection, July 24, and casual visits in August added a few observations. The following collectors undertook the botanical side of the survey:

Marine Algae

Alice E. Brown
Annette Brown
Edward S. Castle
Ralph E. Cleland
Helen Duckworth
Janet P. Jamieson
James B. Lackey
Ivey F. Lewis

Marine Algae (Continued)

Elizabeth L. Mackintosh
Bertha E. Nute
Olga Osterhout
Radcliffe Pike
Ethel G. Stiffler
Wm. Randolph Taylor
Lora S. Weston
William H. Weston, Jr.

Fresh-water Algae

Tracy E. Hazen

Diatoms

Paul S. Conger

Fungi

Helen S. Harper
Robert A. Harper
Margaret Kemp
Neil E. Stevens
William H. Weston, Jr.
Marguerite S. Wilcox

Bryophytes

L. P. Blinks
Sherburne F. Cook
Edith G. Cook

Pteridophytes

Alma G. Stokey

Phanerogams

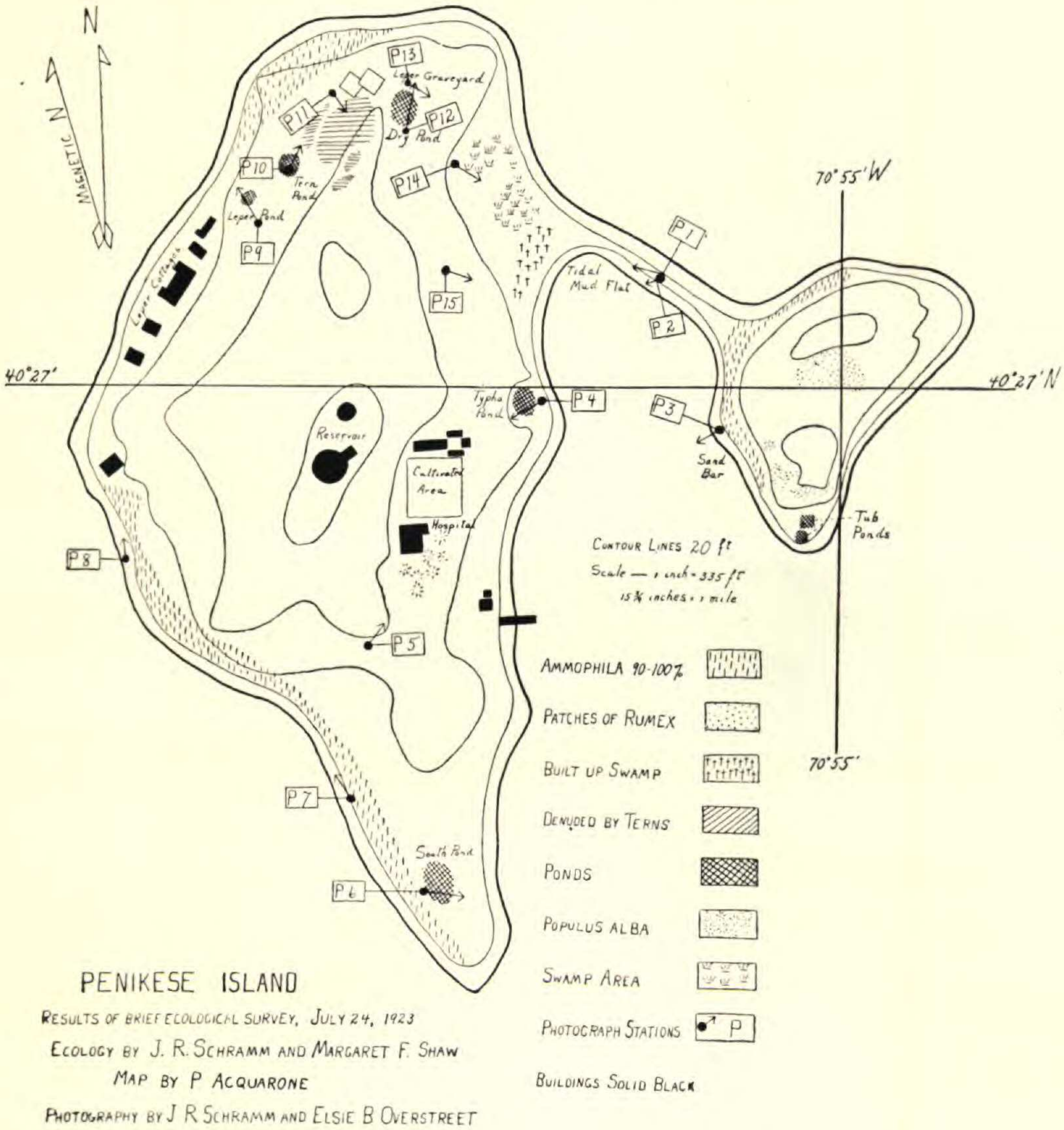
Frederick H. Blodgett
Alice E. Clarke
N. H. Cowdry
John M. Fogg, Jr.
Anne Hof
O. L. Inman
Margaret Sumwalt

Ecology

Paul Acquarone
Elsie B. Overstreet
Jacob R. Schramm
Margaret F. Shaw

The island Penikese is a remnant of the terminal moraine now seen in the Elizabeth Islands. It is about two thirds of a mile long and half as broad, with a broadly spatulate point, for convenience of reference called Tub Point, extending further to the east for another third of a mile. Its contour is dominated by low hills on the main body of the island, with depressions here and there which may be ponds of a rather temporary character (map).

The original vegetation, like that of neighboring islands, is said by Jordan to have been of a forest type, with pitch pine, red cedar, red maple, shagbark, shadbush, poplar birch, hornbeam, and two or three species of sumach. In 1873 there was "no trace left save the rotten roots of a solitary beech stump and a few branches of red cedar



and red maple (?) found buried in the muck of a small swamp." Cutting of the original timber had been followed by the introduction of sheep, which remained on the island until about 1910. From 1905 to 1921 Penikese was used by the State of Massachusetts as the site of a leprosarium. After the removal of the lepers in 1921, the island has been uninhabited except for the caretaker and his wife.

Jordan says that his "list may have a special interest to future students, and also a general interest to botanists, as showing which plants survive a prolonged struggle for existence against grass and sheep." If the State retains possession of Penikese and establishes a bird sanctuary there, the continued history of the development and succession of plants and animals cannot fail to be of interest and importance. Surveys at stated intervals will give precise information

about natural succession under the prevailing climatic and edaphic conditions, and will furnish data on the means of dispersal of species in this region.

ECOLOGY OF PENIKESE.[1]

The ecological survey of the island is here divided into three parts: beaches, grassland, and ponds.

BEACHES. The island is entirely surrounded by a beach of varying width and character. There is a plantless zone between the marine flora consisting almost entirely of algae, and the true beach flora of seed plants. This plantless zone is determined by the tides, being an area covered by water daily.

The zone of beach plants is the area between high daily tide and the limit of storm tide. On Penikese this is indicated by piles of eel grass often amounting to a foot or two in thickness on sheltered beaches. On this eel grass and on sheltered beaches generally grows a group of plants which are able to endure the severe conditions. The following plants appear in this group:

Ambrosia artemisiifolia
Chenopodium album
Cakile edentula
Rumex crispus
Ammophila breviligulata (on mud flats)
Lathyrus maritimus
Ammodenia peploides
Sonchus oleraceus
Datura Stramonium

These plants are found only on the beaches formed of fine sand in sheltered positions (plate 146, upper and middle views). A second type of beach is found on the exposed portions of the island on the north and west shores. Here the fine part of the glacial till of which the island is made has been washed away, leaving rounded stones of varying sizes from huge boulders to small pebbles. This type of beach supports practically no vegetation.

The tension line between the beach plants and the inland forms extends all around the island. It is best shown on the neck where the zone of the south shore merges with that of the north shore to form a band the width of the neck. The dominant plant in this zone is *Achillea Millefolium*, which with its associates shows a considerable dwarfing on this exposed pebbly neck. Along with the Achillea occur also:

[1]By Margaret F. Shaw.

Ambrosia artemisiifolia
Stellaria graminea
Spergularia marina
Rumex Acetosella
Oenothera biennis
Lepidium virginicum
Plantago major
Plantago lanceolata
Anagallis arvensis

GRASSLAND. One of the most striking plant associations is that dominated by Ammophila. This occupies the slopes on the west shores of both the main island and Tub Point, where it begins at the Achillea zone and ends sharply at the crest of the hill. In places it forms lobes stretching up the depressions. Few other plants are found with the Ammophila, which is two to three feet high. These are:

Plantago lanceolata
Achillea Millefolium
Aster vimineus
Polygonum Convolvulus
Solidago sempervirens

The inland grassland extends over the main part of the island, and is dominated by various species of grasses. These are not usually mixed, but are found in more or less pure stands in intermingling patches of different sizes. The most abundant of the inland grasses are *Agrostis alba*, *Agropyron repens*, *Anthoxanthum odoratum*, *Festuca rubra*, and *Holcus lanatus*. Somewhat less common are *Dactylis glomerata*, *Danthonia spicata*, and *Festuca elatior*.

In places where the soil is of a poorer quality, *Rumex Acetosella* is found in solid mats so thick that it gives a red tone to the slopes. It seems likely that such patches mark the spots denuded of vegetation in previous years by the nesting terns mentioned below.

The vegetation of the grassland, like that of the rest of the island, has not advanced beyond the herbaceous stage in its ecological development. While a number of herbaceous plants are found with the grass, the only shrubs are a few plants of *Rhus typhina*, a few feet high, on the east slopes, a few specimens of *Sambucus canadensis* on the northern end of the island, one small plant of *Myrica carolinensis* south of the dock, and one or two seedlings of *Quercus rubra* between the reservoir and the eastern shore. The island has been overrun by sheep in the past, but these have not been present for more than ten years.

Among the more common plants of the grassland area are:

Agropyron repens
Agrostis capillaris
Anthoxanthum odoratum
Festuca rubra
Rubus procumbens
Stellaria graminea
Hypericum perforatum
Lepidium virginicum

Festuca elatior
Holcus lanatus
Dactylis glomerata
Danthonia spicata
Poa pratensis
Phleum pratense
Rumex Acetosella
Achillea Millefolium
Daucus Carota
Solidago sempervirens
Solidago rugosa
Verbascum Thapsus
Potentilla argentea
Oenothera biennis
Oxalis stricta
Lychnis alba
Chrysanthemum Leucanthemum
Aster undulatus
Trifolium arvense
Trifolium pratense
Trifolium agrarium
Trifolium repens
Sonchus arvensis
Asparagus officinalis
Rudbeckia hirta
Cirsium arvense
Cirsium lanceolatum
Dennstaedtia punctilobula
Linaria canadensis

One interesting retrogression in the development of the vegetation is due to the nesting habits of the terns. These occupy the bare ground so thickly that large areas are denuded of vegetation (plate 147, upper view). When these nesting areas are abandoned the first results are similar to those of the abandonment of cultivated land, running at once to weed forms such as:

Solanum nigrum
Lepidium virginicum
Chenopodium album
Amaranthus retroflexus
Anagallis arvensis
Erigeron canadensis
Sonchus arvensis
Capsella Bursa-pastoris

Ponds. The ponds are of two types, first, low ponds quite near the shore, tending to be brackish, second, higher ponds formed in kettle-holes. The low ponds show nearly the same development. A center of open water containing a scum of floating algae is surrounded by a zone of sedge, a zone of *Spartina patens*, and an irregular zone of *Iris versicolor* marking the line of tension between the pond vegetation and the grassland. The filled marsh on the east of the island near the neck shows the further development of the marsh stage. Here a larger number of plants are found, of which the commonest are:

Rumex crispus
Convolvulus sepium
Scutellaria epilobiifolia
Lycopus uniflorus
Polygonum Convolvulus

The kettle-hole type of pond is entirely freshwater in character. Typha Pond, on the east side of the island between the residence and the neck, is in a deep depression, and has a Typha zone surrounded by a band of Juncus, outside which comes the Scirpus zone. The marsh stage here is well developed, containing:

Typha latifolia	Galium trifidum
Juncus acuminatus	Lycopus uniflorus
Scirpus paludosus	Scutellaria epilobiifolia

There are willows at both ends of this pond, indicating a natural shrub stage, provided they were not planted (plate 146, lowest view).

The ponds on the northwestern part of the island are very shallow, and show a rank growth of *Bidens connata*. The most northerly pond ("Dry Pond") had contained water in the spring, as its surface was cracked mud with no seed plants (plate 147, lower view). The south pond of this group ("Tern Pond") contains water buttercup, a remnant of rushes, the Spartina zone, and a marsh zone with *Aspidium Thelypteris*.

As the early records of the island mention trees belonging to forests of an advanced type, it is possible that such a forest may again develop, provided the island is neither pastured nor cultivated. There are three possible ways, aside from human agency, for seeds to reach the island, by means of birds, wind, or water. As the only birds which live on the island are sea birds that eat fish, and small birds of the sparrow type, with occasional crow or blackbird visitants, the probable means of seed introduction by birds occurs only in time of migration. The vegetation today indicates that it is isolated, as a common form like poison ivy is not found on the island, while it is one of the conspicuous features of the vegetation of neighboring islands and mainland. In 1873 this species was recorded from Gull Island, but it has disappeared completely.

GULL ISLAND.

Gull Island, which was included in Jordan's original survey, is much smaller than Penikese, and lies nearly half a mile to the southeast. The island is in two parts, the larger reaching an elevation of ten feet with the vegetation mostly in the upper central zone. The smaller portion, or bar, is bare of vegetation; it is connected with the main island at dead low water by a narrow neck.

On the northwest end of the crest there is a grassy district with a tall growth of Solidago, Achillea, Rumex, and Convolvulus. This area is extended toward the center by Ambrosia, Cakile, and Atriplex. A patch of Lathyrus lies on the eastern side. The southeast end of the crest is covered with especially luxuriant Ambrosia, with some Atriplex and a little grass. On the eastern side of the shore an arm of marshy land extends some distance, and is covered with *Spartina alterniflora*.

The small size, the low elevation, and the free exposure render it likely that the vegetation of Gull Island is now in its permanent form, and not likely to tend toward the forest type which in time, without interference by man, will probably dominate Penikese.

CHANGES IN THE FLORA.

Considerable changes in the flora have taken place since 1873. In that year Jordan listed 114 species of ferns and seed plants, of which 44 were not found in the present survey. It is not possible to be sure of the exact number, since the more detailed knowledge of the present day has given a more precise definition of species, and it is likely that in a few cases the same plant has been called by one name in Jordan's list and by another in the present paper. Although synonymy has been taken into account, the possibility still remains, for example, that Jordan's *Cerastium viscosum* is our *C. vulgatum*, *Archangelica Gmelini* may be *Ligusticum scothicum*, *Lycopus europaeus*, *L. americanus; Polygonum Hydropiper*, *P. acre; Atriplex patula*, *A. hastata; Festuca ovina*, *F. rubra*. Making all possible allowances for such corrections, it still remains obvious that many, perhaps two score, species present on the island fifty years ago have disappeared, victims perhaps of the grazing that continued for many years.

On the other hand, the present list contains 166 species, no less than 94 being new to the Penikese flora. The presence of such a large number and proportion (57%) of invaders indicates that ecologically the island is progressing rapidly, since it has not been free of sheep for more than a dozen years. The record of its further changes should be followed carefully by the botanists of this region as giving a clear picture, very definitely outlined, of vegetational succession in a circumscribed area.

The largest group of introduced species (30) have seeds which are without special adaptation for dispersal. These, most of which would be classed as weeds, were probably introduced accidentally along with garden seeds or in hay or otherwise. Many of them are found in the neighborhood of the hospital garden. Another considerable block (20 species) has been introduced directly by man, and many of these seem in a fair way to become thoroughly established. Of the remaining species, fifteen have wind-borne seeds, thirteen are found in or near ponds and may have been brought in among mud on the feet of birds, eleven have berries or fruits which are adapted to dispersal by seed-eating birds, two are beach plants which may have

been brought by currents, two are adapted to dispersal by animals, and one (Quercus) does not belong in any of these categories.

It seems likely that man is the most efficient agent for the introduction of new species, birds second, and wind third, while other agencies are relatively unimportant.

MARINE ALGAE.

As might be expected, the marine algae of Penikese differ with differing location and exposure. On the rocky northwest shore, where deep water comes close to the land, the dominant species are the larger tougher Phaeophyceae, such as Ascophyllum, Fucus, Laminaria, Chordaria, and Dictyosiphon, with some Ectocarpus and Elachistea. The only common green alga is Cladophora, while the Florideae are represented especially by Cystoclonium and Corallina. Noticeably absent are the Polysiphonias, Ceramiums, Mesogloia, and other feathery species which are very abundant in the region generally.

In the bay on the southwest shore there is distinctly less of the rockweeds, while *Polysiphonia fastigiata* is abundant, with much small Leathesia. Dictyosiphon is also common here, as are Ralfsia and Corallina.

The southern end of Tub Point was explored carefully as being representative of the type of shore seen all around the island except to the eastward. The rocky shore runs out southward to several large boulders exposed at low water. Here are Fucus and Ascophyllum in abundance, with Calothrix forming a dense turf on them, and much Cladophora on the boulders. On the rocks nearer the shore Ralfsia, Hildenbrandtia, Lithothamnion, and Protoderma are common. On the Fucus are found Chondria, Polysiphonia, Ceramium, Leathesia, and Elachistea. A little deeper occur Mesogloia, Chordaria, and Dictyosiphon. At a depth of three feet or so are found Chorda, *Laminaria Agardhii* and *L. digitata*, Scytosiphon, Punctaria, and Corallina. In the deeper water, from four to six feet, the common forms are Phyllophora, Chondrus, Ahnfeltia, and *Laminaria Platymeris*.

The eastern side of the island is fringed with eel grass, with fairly shoal water extending out some distance. Here the algal flora is relatively sparse, and quite different from that characteristic of the more exposed and rocky shores. The representative forms here are

Ulva, Enteromorpha, Cladophora, Rhizoclonium, *Anabaena torulosa*, *Oscillatoria margaritifera*, Porphyra, and Ectocarpus.

On Gull Island the northwest and west sides are comparatively bare of algae. Toward the northeast end large rocks are scattered as far out as one large boulder. The flora here is largely composed of rockweed, with Elachistea and Sphacelaria on the Fucus and *Polysiphonia fastigiata* on the Ascophyllum. Much Punctaria is present, bearing *Isactis plana* and *Calothrix fuscoviolacea*, with *Polysiphonia nigrescens* and Mesogloia also common. On the eel grass is an abundance of *Melobesia LeJolisii* and *Rhododermis Georgii*. On the large boulder is a fine growth of *Prasiola stipitata*, and in a little pool on the top much *Platymonas subcordiformis*.

On the east side rocks extend out beyond a patch of Spartina on the shore, and here, in addition to the species noted above, luxuriant *Polysiphonia urceolata formosa*, Dictyosiphon, and Punctaria are found.

On the bar at the southeast end of Gull Island few algae are to be seen on the east side, where the bottom is covered with cobbles, with a few tufts of rockweed on the larger stones. On the west side, however, algae are abundant. The rockweeds bear Elachistea, Dictyosiphon, and Mesogloia abundantly. In the deeper water, especially toward the northwest end, Melobesia is common on the eel grass, and much Chorda is also found. Covering much of the bottom is a heavy growth of *Anabaena torulosa* and *Oscillatoria margaritifera*. The smaller algae, besides being fouled with these species, are covered here and there with *Calothrix confervicola*.

A comparison of the marine algae found with those listed by Jordan shows that there has been a considerable change in the marine flora since 1873. Excluding species not now recognized by systematists, Jordan listed 25 species which were not found in the course of the survey. Of these 8 belonged to the Chlorophyceae, 2 to the Phaeophyceae, and 15 to the Rhodophyceae. On the other hand the collections of 1923 show 43 species and 9 varieties not represented on Jordan's list, of which 11 belong to the Myxophyceae, 9 to the Chlorophyceae, 13 to the Phaeophyceae, and 19 to the Rhodophyceae. Of these, in addition to the Myxophyceae, which are very poorly represented in Jordan's list, 9 species are either very small or parasitic and likely to have been overlooked by Jordan at a time when knowledge of such forms, at least in this country, was little advanced.

However, 14 species, now so abundant both at Penikese and in the surrounding waters as to be fairly considered as representative species of the present flora and by no means likely to be overlooked, were missing in 1873. These are:

Anabaena torulosa
Chaetomorpha Linum
Enteromorpha Linza
Chorda filum
Desmarestia aculeata
Ectocarpus confervoides
Ectocarpus fasciculatus
Punctaria latifolia
Ralfsia verrucosa
Scytosiphon lomentarius
Chondria Baileyana
Nemalion multifidum
Phyllophora membranifolia
Polysiphonia fibrillosa

On the other hand, Jordan lists some species which are now abundant in the general region, the absence of which at Penikese is surprising, though it is perhaps to be explained by the short time devoted to the survey. Such species as those included in the following list are certainly to be expected at Penikese, even though the rich list of Callithamnions and of the more delicate Polysiphonias given by Jordan is not likely to be duplicated at the present time.

Cladophora gracilis
Enteromorpha clathrata
Sargassum filipendula
Antithamnion americanum
Callithamnion Baileyi
Dasya elegans
Griffithsia globifera
Polysiphonia variegata

DIATOMS.[1]

The island of Penikese has been inaccessible until recently because of its use as a State leper colony, and this, together with its somewhat isolated location, lends rather more than usual interest to the flora found there. Its small size, isolated location, and the nature of its topography form a rather severe set of factors in limiting the diatom species found in this flora. The island has a number of small ponds, and those which are not low enough to be subject to occasional invasions by the waves and tides of the sea are replenished only by the frequent rains which fall in that region, and hence are subject to occasional drying-up in periods of extended drought. From the former are excluded such diatoms as are not brackish in habitat or else not hardy enough to stand changes in the salinity of the water. Occasional drying-up of the other ponds may be somewhat of a factor in their diatom life, although the humidity of the atmosphere and the brevity of such dry periods probably allows the diatom life to go on

[1] By Paul S. Conger, Carnegie Institution of Washington.

without serious interruption. The isolation of the island, lack of inflowing streams, etc., very greatly limit the chance of importation of new diatom species to these ponds.

The map shows the locations where diatom samples were secured. All of the ponds are very small and shallow. The samples were dredged at a depth of about one foot, except in the cases of the marsh and Dry Pond, both of which had dried to a condition of cracked mud, and here some of the surface was collected. The diatom flora of any of the ponds is, as intimated, rather meager, and in several of them the conditions seem to have been favorable to the rapid multiplication and growth of a certain single species. In Typha Pond *Navicula elegans* W. S. is very abundant, in Tub Ponds *Navicula peregrina* E., and in South Pond *Navicula formosa* Greg. is dominant. The finding of a mixture of distinctly fresh- and salt-water forms in several of the ponds is probably not difficult to understand. Dr. H. W. Henshaw has suggested that the isolation of the island and the small amount of fresh water on it places the latter at a high premium with the terns and other aquatic birds which make their home and nest there by the thousands. Hence it is easy to see how marine diatoms would be carried by them to the fresh-water ponds where they must necessarily go daily by thousands to drink. Overflow by the sea in times of high tide or high winds would also help to explain the presence of marine diatoms in those ponds of lower elevation and in the marsh.

Two species of Navicula have proved indeterminate thus far, and the following fresh-water form is new.

Navicula nanella P. C. sp. n. Valve elliptical with broad obtuse ends and straight taper from the center to the ends. Lunate thickening across extreme ends of valve from the terminal nodule to the margin. Central area broadened laterally. Arrangement of costae giving appearance of a double dark band across the valve near center when dry. Raphe straight, slightly swelling at the center. Costae widely spaced, heavy, smooth, and reaching nearly to the raphe, radiate from the center half way to the end of the valve, and convergent from thence on to the end. Length 0.023 mm. Width 0.008 mm. Striae 8½ in 0.01 mm.

Fresh water.

This species presents some likeness to *Navicula hungarica* Grun. (1860), see Cleve, Nav. Diat. II, p. 16, but if so, Cleve's interpretation of the strongly marked costae on either side of the terminal nodule must refer rather to an internal thickening of the valve at this point,

as shown by a careful study of the girdle view. Also Cleve's figures show a strong central dilation not present in this species. He also implies that the costae are striate which is certainly not the case here.

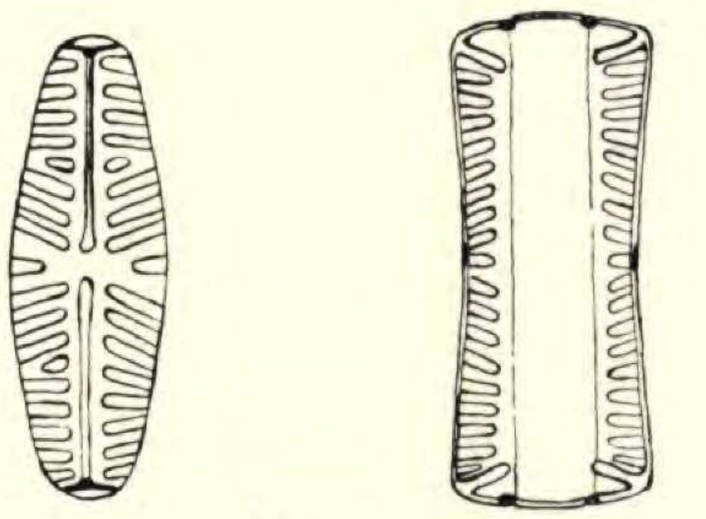


Fig. 1. Navicula nanella P. C. sp. n. × 1000

The identifications of the Penikese diatom species were verified by Dr. Albert Mann, Diatomist of the Carnegie Institution of Washington. Following is a list of the species, separate for each pond or sample, and a complete list of all the species from the island.

Penikese Island Harbor—Plankton Diatoms.

Achnanthes longipes Ag.
Actinocyclus Ehrenbergii Ralfs
Actinoptychus undulatus E.
Chaetoceros coarctatum Laud.
Chaetoceros decipiens Cl.
Chaetoceros didymum E.
Chaetoceros (Bacteriastrum) varians Laud. forma furcata Grun.; Disc. 0.028 mm. diam.
Cocconeis scutellum E.
Coscinodiscus excentricus E.
Fragillaria hyalina K.
Grammatophora marina K.
Licmophora flabellata Ag.
Licmophora Lyngbyei K.
Licmophora tincta (Ag.) Grun.
Mastogloia exigua Lewis
Melosira Borreri Grev.
Melosira sulcata K.
Nitzschia closterium (E.) W. S.
Nitzschia longissima (Bréb.) Ralfs
Nitzschia Sigma W. S.
Pleurosigma elongatum W. S.
Rhabdonema Adriaticum K.
Rhizosolenia hebetata var. semispina (Hensen) Gran.
Rhizosolenia setigera Brightw.
Striatella unipunctata Ag.
Synedra Hennedeyana Greg.
Tropidoneis Lepidoptera (Greg.) Cl.

Penikese Island Harbor—Bottom Diatoms.

Dredging-depth 2 feet, near shore.

Achnanthes longipes Ag.
Actinocyclus crassus W. S.
Actinoptychus undulatus E.
Amphora Grevilleana Greg.
Amphora obtusa Greg.
Auliscus caelatus var. strigillata A. S.
Biddulphia Favus (E.) V. H.
Campylodiscus Thuretii Bréb.
Cocconeis scutellum E.
Coscinodiscus excentricus E.
Coscinodiscus Oculus-Iridis var. Morsiana Grun.
Eupodiscus Argus E. (=Aulacodiscus Argus (E.) A. S.).
Grammatophora macilenta W. S.
Grammatophora marina Grun.
Grammatophora serpentina E.
Hantzschia marina (Donk.) Grun.
Hyalodiscus stelliger Bail.
Melosira sulcata K.
Navicula aspera E.
Navicula Bombus E.
Navicula clavata var. caribaea Cl.
Navicula didyma K. & E.
Navicula distans (W. S.) Cl.
Navicula exempta W. S.
Navicula forcipata var. densistriata A. S.

Penikese Island Harbor—Bottom Diatoms.—(*Continued.*)

Navicula fusca Greg.
Navicula Hennedeyi W. S.
Navicula humerosa Bréb.
Navicula interrupta K.
Navicula Lyra E.
Navicula Lyra var. dilatata A. S.
Navicula Lyra var. elliptica A. S.—Sch. At. 3:11.
Navicula Lyra var. elliptica A. S.—Sch. At. 2:29.
Navicula maxima Greg.
Navicula notabilis var. expleta A. S.
Navicula palpebralis var. angulosa Greg.
Navicula quadratarea A. S.
Navicula Smithii Bréb.
Navicula suborbicularis Greg.
Navicula Yarrensis Grun.
Nitzschia longissima (Bréb.) Ralfs
Nitzschia Sigma W. S.
Pleurosigma aestuarii W. S.
Pleurosigma affine Grun.
Pleurosigma elongatum W. S.
Podocystis Americana Bail. (=Podocystis Adriatica K.).
Rhabdonema Adriaticum K.
Scoliopleura latestriata (Bréb.) Cl.
Surirella recedens A. S.
Synedra Gaillonii var. macilenta Grun.
Trigonium alternans (E.) Cl.

Tern Pond.

Cyclotella comta (E.) K.
Navicula Brauni Grun.
Navicula dicephala (E.) W. S.
Navicula major K.
Navicula viridis Nitzsch
Pseudo-eunotia doliolus (Wall.) Grun.

Dry Pond.

Grammatophora marina K.
Hantzschia amphioxys Grun.
Navicula borealis E.
Navicula Brauni K.
Navicula dicephala (E.) W. S.
Navicula major Grun.
Navicula peregrina E.
Navicula viridis Nitzsch
Nitzschia fonticola Grun.

Marsh.

Actinoptychus undulatus E.
Auliscus caelatus Bail.
Biddulphia favus (E.) V. H.
Hyalodiscus stelliger Bail.
Melosira sulcata forma coronata Grun.
Navicula elegans W. S.
Navicula major K.
Navicula peregrina E.
Nitzschia scalaris W. S. (Wide variety).

Typha Pond.

Cyclotella comta (E.) K.
Hyalodiscus stelliger Bail.
Navicula ambigua Cl.
Navicula borealis E.
Navicula dicephala (E.) W. S.
Navicula elegans W. S.
Navicula (Stauroneis) gracilis E.
Navicula Hantzschiana Rab.
Navicula major K.
Navicula nanella P. C. sp. n.
Navicula rhynchocephala K.
Navicula viridula K.
Nitzschia frustulum var. perminuta Grun.
Surirella Mölleriana Grun.
Tabellaria fenestrata (Lyngb.) K.

TUB POND.

Coscinodiscus excentricus E.
Coscinodiscus nodulifer A. S.
Coscinodiscus radiatus E.
Hyalodiscus stelliger Bail.
Navicula peregrina E.
Tropidoneis Lepidoptera (Greg.) Cl.

SOUTH POND.

Coscinodiscus excentricus E.
Eupodiscus Argus E. (=Aulacodiscus Argus (E.) A. S.).
Grammatophora macilenta W. S.
Hyalodiscus stelliger Bail.
Melosira sulcata K.
Navicula formosa Greg. (Dominant form here).
Navicula (Stauroneis) Gregorii Ralfs
Navicula peregrina E.
Rhabdonema Adriaticum K.
Tropidoneis Lepidoptera (Greg.) Cl.

(To be continued.)

A NEW SPECIES OF RHIZOPOGON FROM NEW HAMPSHIRE.

DAVID H. LINDER.

(Plate 148.)

THE genus *Rhizopogon*, a member of the *Hymenogastraceae*, belongs among the higher *Basidiomycetes*, and is a group of puffball-like subterranean fungi. It differs from the puffballs in that the gleba does not break down and leave a cavity filled with spores and capillitium, but retains the septa that divide the persisting gleba into small cavities which at maturity are filled with spores and have no capillitium.

It was the writer's good fortune while spending the summer at Camp Algonquin in Holderness, New Hampshire, to find there in moist woods consisting chiefly of white birch,—*Betula alba* var. *papyrifera* (Marsh.) Spach,—but with here and there a group of hemlock trees, a fungus resembling *Rhizopogon occidentalis* Z. & D.[1] It was on an old, almost decayed stump in one of these groups of hemlock trees that this hypogeous fungus was found where it had been dug from near the base of the stump, presumably by a chipmunk which had carried it up to eat at leisure, and there had left it on being frightened by passers-by.

The fungus when fresh was bright lemon-yellow, subglobose, and slightly lobed, measuring somewhat over three centimeters in diam-

[1] Zeller, S. M., & Dodge, C. W.— 'Rhizopogon in North America." Ann. Mo. Bot Gard. **5:** 1–36. 3 pls. 1918.